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December 13, 1994

The Honorable Susan Ness
Commissioner
Federal Communications Commission
1919 M Street, N.W., Room 814
Washington, D.C. 20554
STOP CODE: 0101

Re: Ex Parte Communication
PR Docket No. 93-61
Automatic Vehicle Monitoring

Dear Commissioner Ness:

In response to your request at your Round Table Meeting on AVM Issues on Wednesday, December 7, 1994, we respectfully submit to you the attached description of Pinpoint's most recent specific proposals for eliminating the Part 15 fears of arbitrary shutdown and interference. Pinpoint proposes (i) the use of a "Busy Channel Indicator" technique; and (ii) an explanation of how the wide band forward link in the Pinpoint architecture may be rendered unthreatening.

Pinpoint's serious and highly pragmatic proposals are designed not merely to satisfy a selfish interest, but sympathetically to take into consideration the complaints and problems of all the residents of the band who have not rejected sharing. We are seeking a WIN-WIN situation for all band participants with the minimum of pain to all. Indeed, just yesterday, Larry Irving, Assistant Secretary, National Telecommunications and Information Administration, United States Department of Commerce, emphasized in a letter to Chairman Hundt filed in this proceeding that "regulatory initiatives are needed to encourage and support licensed and nonlicensed services that most efficiently use and *share* spectrum." (my emphasis)

As responsible "citizens" of the 902-928 MHz Band, we must satisfy our responsibility to design products to accommodate the use of the band by others and to facilitate the sharing process. The prize for us all -- the whole community in the band -- is a band of spectrum that carries far more traffic and thereby accommodates a larger population than it otherwise would. Thus, just as AVM proponents should try to design coexistence into the very core of their technologies (and

should have expectations of being able to continue to operate if they do), Part 15 producers must also design a reasonable and responsible level of robustness into their products in order to endure inevitable modest noise levels from other Part 15 devices, as well as AVM systems. It is plainly unreasonable for any parties, whether AVM or Part 15, to design their products to operate at the noise threshold (*i.e.*, with zero tolerance for other occupants of the band) and then turn around and complain that everyone else is to blame for their lack of robustness.

We believe that our proposals present the opportunity for a notable victory in this proceeding, but we need the leadership of the Commission to push us to the goal line. We can achieve important public policy objectives in the process: we can maximize the productivity of this spectrum; maximize the OPPORTUNITY for technology innovation; maximize the CHOICE available to consumers; and establish the FAIRNESS of a level playing field for competitors.

Respectfully submitted,

Patrick Bromley
Chairman of the Board

PB:df
Attachments

cc: David R. Siddall, Esq.
William F. Caton (2 copies)

PROPOSED STEPS TO INCREASE COMPATIBILITY OF PART 15 DEVICES WITH WIDE-AREA AVM

SUMMARY AND OVERVIEW

With respect to matters of mutual interference, the Part 15 Coalition has expressed concern principally over two issues. First, Part 15 is concerned over the potential for unlicensed devices to cause interference to wide-area automatic vehicle monitoring ("AVM") systems. Pinpoint believes that unlicensed devices operating at less than one watt in an uncoordinated fashion will very rarely cause unmanageable interference to Pinpoint (and we have no evidence to the contrary). In contrast, networks of high-powered coordinated device systems such as Metricom and Cell-Net will pose a significant potential for such interference. As a result, Coalition members are concerned that Part 15 devices will be at risk of being forced to shut down unilaterally by an AVM system with superior spectrum rights in the band because they caused harmful interference to the AVM system.

Pinpoint does not want to shut anyone down for interference unwittingly and unexpectedly caused. The "Busy Indicator" signal described below will allow every Part 15 producer with the potential for causing harmful interference to AVM systems, at a very modest cost per device, to ***guarantee*** for themselves that they will avoid unknowingly causing such interference, and ***eliminate*** the fear of being unilaterally shut down. The technique proposed herein would act like a traffic light that coordinates the movement of traffic across a busy intersection. The techniques would ensure that traffic flows smoothly, without collisions, and without the necessity of anyone "owning" exclusively a piece of roadway to travel safely.

Second, a few members of the Part 15 coalition have expressed concern about the Wide Band Forward Link in Pinpoint's ARRAY™ system. Specifically, they have been particularly fearful that Pinpoint will, in the future, elect to operate this link, not at the 500 W ERP levels currently used by Pinpoint, but at the much higher power levels actually permitted under the current rules and that might be allowed under revised rules. To provide comfort with respect to this concern expressed by the Part 15 community, Pinpoint would support a prohibition of operating AVM base stations above the 500 W ERP level.

Regarding the operation of the Wide Band Forward Link apart from power levels, Pinpoint believes that the critics of this technique have overstated the interference potential of such links, particularly as it relates to Pinpoint's network design. The paragraphs below discussing base station transmit duty factors and the aggregation of a base station's transmissions are offered to help to clarify these issues. In conjunction with revised power limitations which we would support, Pinpoint hopes these operational constraints will resolve essentially all of the concerns that have been expressed with regard to the Wide Band Forward Link.

With these limits on maximum transmit power level, low maximum duty factors, low energy density and short communication range, the potential for interference between unlicensed devices and the wideband forward link used by high-speed radiolocation systems will be very small.

Where such interference does occasionally occur, Part 15 devices would rely on the robustness features already typically designed into them to ameliorate the effects of any such interference in order to accommodate the requirements of Section 15.5(b).

CONSIDERATIONS:

Spectrum Sharing Through a Busy Channel Indicator

As the wide-area AVM proponents and the wide-area Part 15 proponents have learned more about each other's systems, it has become increasingly apparent that neither type of system, even at peak usage, needs make full time use of the spectrum, everywhere, simultaneously. For example, even in a Pinpoint system with 30 base stations spaced 5 to 10 miles apart, average on-the-air time for a given base station ***in a fully loaded system operating at peak capacity*** is less than one percent of the time the base station has access to the spectrum.

If there were a way for the Part 15 operators to transmit when the AVM systems were not "listening" to its own transmissions, both types of systems could make more efficient use of the spectrum, and without colliding with each other. The unlicensed devices would be able to satisfy the non-interference requirements for band use, even when the signal levels used would otherwise debilitate one or another system when they occupied the same spectrum "time and place." All of this can be achieved without the need to change the existing hierarchy of service priorities.

The Busy Channel Indicator technique proposed herein would act like a traffic light that coordinates the movement of traffic across a heavily used intersection. When everyone obeys the traffic-light rules, the traffic flows smoothly, without collisions, and without the necessity of anyone owning a piece of roadway to travel safely. It is offered as an example of the way in which technical/cooperative solutions can reduce the incompatibilities that are otherwise likely to arise from the operation of unlicensed devices and wide-area AVM systems in the same spectrum.

To accomplish such cooperation requires a simple and inexpensive mechanism for providing coordination between the licensed and the unlicensed operators. Such a technique could allow Part 15 devices with high interference potential to fulfill their noninterference obligations without a major reduction in their overall access to the spectrum. Pinpoint suggests that the licensed operators transmit a simple "busy indicator" signal on a low-powered narrow-band channel when they require "quiet" in the band within the local "coverage area" of this "busy indicator" channel transmitter. Those unlicensed devices with a high probability of causing interference could monitor this local channel. When the "busy signal" is detected, the high powered Part 15 devices could silence their own transmissions that are within the spectrum of the wide-area AVM and within the "coverage area" of the busy signal, until the busy signal changed state to indicate that it was "safe" to resume transmissions.

We believe that this Busy Channel Indicator could be utilized by all AVM operators, regardless of where in the band they operate. This would ensure maximum access of Part 15 devices to the AVM spectrum, thereby maximizing the productivity of the spectrum not fully utilized by the AVM systems.

Wideband Forward Link and AVM Duty Factors

Some parties in PR Docket No. 93-61 have expressed a concern that the wideband forward link used in some of the high-speed AVM systems may cause severe and widespread interference to many low-powered Part 15 services now or soon to be in operation. To some degree, this fear results from simplistic path-loss propagation analyses based on the incorrect assumption that a wideband forward link means that all base stations within an AVM system would transmit at peak levels continuously and simultaneously. Some of these analyses have also assumed that AVM base stations employing a wideband forward link would operate at power levels much higher than are or will be used. Actual operating parameters of AVM systems that will use a wideband forward link are much different, requiring a radical reassessment of any expectations of interference from a wideband forward link.

For example, Pinpoint's system, designed for use under the interim AVM rules, functions in "half-duplex" fashion without simulcasting. Within a "frequency reuse area" (the area covered by about 30 base stations with approximately 5 to 10 mile spacing) only one base station is permitted to transmit polling or message or control signals at a time. (For the majority of the time, even at peak periods, not a single base station within the reuse area will be transmitting.) Simultaneous base station transmissions within such an area would cause self-interference.

To understand the real impact of the AVM network on airtime, it is important to understand latency. Transaction latency is a very important aspect of the ARRAY AVM system's service offering. Transaction latency is the delay between making a request for service and its being accomplished. (Why is it so important? There is little point in getting frequent or accurate updates of a police car's position if the reported position is that of thirty or more seconds ago, by which time the vehicle may be more than half a mile from the reported position). Therefore, it is a specific design requirement to provide "apparent excess capacity" so that the "bursty" nature of the transaction traffic does not force the response time during transient traffic peaks to be drawn out due to queuing. Pinpoint has allowed a factor of 3 for the peak-to-average ratio, meaning that when the network is handling its design maximum traffic, the average traffic will be less than a third of "theoretical maximum" of either vehicle location or message delivery, *i.e.* the maximum-average number of randomly addressed position fixes would be 500 per second out of a "theoretical peak maximum" of 1500 per second. The network *as a whole*, however, transiently may still be performing randomly addressed position fixes at up to 1500 per second when required!

Because the entire AVM traffic load (both radio-location and related data) is carried by these 30 base stations, each base station, on average, carries only about 3% (*i.e.* one thirtieth) of the network's traffic load within the "frequency reuse area." For most of the location traffic, which represents the majority of the network's operational services, the average base station's transmission occupies the air for about 1/3 of time devoted to this traffic. Thus, ***on a fully loaded system functioning at 100% theoretical peak capacity,*** the typical base station, on average, ***transmits for less than 1% of the time.***

In actual operation, traffic on a *fully subscribed* system is likely to use only a small fraction of the 100% "theoretical" capacity. This apparent reduction is to allow for transient peak loading without causing significant increases of latency delay. Therefore, the *busiest* base station is likely to have an *average transmit duty factor of less than 3%*, even when the busiest base station carries 10 times the load of the average least busy base stations. Allowing further that transient peaks in message-radiolocation traffic are three times that of the average traffic, would still mean that the busiest station would be transmitting, transiently, with *peak duty factors* of less than 10%. We must reiterate that these values of airtime duty factors are based on "theoretical maximum" values, only practically achievable under "diagnostic" conditions and theoretical-maximum demand.

In reality, the values will be very much smaller than these maximum values, typically as much as 5 to 30 times less even for fully loaded systems, with transient traffic peaks only occasionally approaching these theoretical levels. Practical maximum "average" load levels are expected to grow over time, as various applications penetrate their markets and the number of subscribers increases. Furthermore, it will take many years for the network traffic to build to these levels, just as the growth of the Part 15 device population will take time. The prediction, by Part 15 interests, of instantaneous, traumatic impact are very overstated.

Wide Band Forward Link Proposals:

The above discussion demonstrates that when a Part 15 device operates in such close proximity to an AVM base station using a wideband forward link that a transmitting base station will cause interference, the likelihood of debilitating interference from that base is very small. To reduce that small chance even further (in addition to the power level limitation discussed in the *Summary and Overview*) Pinpoint proposes the following restrictions on a wideband forward link:

1. The 918-926 MHz band should be shared among wide-area AVM systems capable of time-sharing, local-area AVM systems, and compatible Part 15 devices (*i.e.*, all Part 15 devices that do not disable wide-area AVM systems for more than some acceptable percentage of the time over more than some acceptable percentage of the AVM license area).

2. Resolution of interference situations between wide-area and local-area AVM systems will be through established procedures under the mutual cooperation mandates of Section 90.173(b) of the FCC Rules. The second operator would have the obligation to install its system in a manner that minimizes the potential for interference, but both operators in an interference dispute would have the obligation to seek and make modifications to their own systems to eliminate or reduce the harmful interference. Detailed additional procedures could be established by the FCC subject to notice and comment requirements.

3. All Part 15 operations will still be subject to the current hierarchy rules. Part 15.5, like Section 90.173(b), could be augmented by a more definitive dispute resolution process or etiquette, rather than the current rules, for instances of interference between wide-area AVM systems and unlicensed devices.

4. Steps should be taken to keep the potential for interference from wideband forward links to Part 15 devices to a minimum. Some ways of doing this are:

   - Ensure that the transmit energy per unit bandwidth of a wideband forward link is low. Accordingly, Pinpoint reiterates that it is willing to accept a base station power limitation of 500 W ERP.

   - Ensure that the time-probability of collision between a wideband forward link and a Part 15 device is small.

Regarding the first bullet above, it should be noted that the spectral energy density of the Pinpoint system's forward link currently is designed (at 500 W ERP) to operate with an energy density similar to that of a Part 15 frequency-hopping spread spectrum system operating at 4 W EIRP

Pinpoint's ARRAY™ system is fully capable of satisfying the second bullet as well. With the few simple duty-factor restrictions on the licensed service illustrated below, the quality of access to the shared spectrum would be very much higher for both the licensed and unlicensed users of the band. In addition, the time and spatial diversity characteristics of their respective operations would allow both systems significantly better access to the whole available band than if the band were narrowly frequency-partitioned in "dedicated fashion" for each individual user or group of users. At a small compromise in cost and operational complexity, wide-area AVM and wide-area high-powered Part 15 users alike could gain very significantly greater quality and capacity from the band.

While the actual expected average and peak duty factors expected from any particular AVM system using a wideband forward link would typically be much lower than the limits suggested below, the values offered below indicate the levels we feel are of the right magnitude for generally applicable regulations. Such values would reserve system flexibility on system designers planning new or different systems without undermining compatibility with Part 15.

The duty-factor limitations could take the following form:

(1) Any particular licensed base station shall keep its duty factor below a certain percentage (3% average and 10% peak), where duty factor is defined as (total transmit time in any 100 second integrating interval)/(100 seconds);

(2) Any local group of base stations (defined as any base station and the six base stations closest to it) shall keep its cumulative duty factor below another, somewhat higher, percentage (10% average and 30% peak);

(3) The transmission patterns of individual base stations shall consist of tightly-bunched groups of transaction "bursts," interspersed by much longer inactive periods of at least some minimum limit (300 milliseconds). See Figure 1 below; and

(4) The maximum "silent-gap" between transmissions within each such "burst" shall not be greater than 1 millisecond. Figure 1 illustrates the "bunching" notion and its implementation.

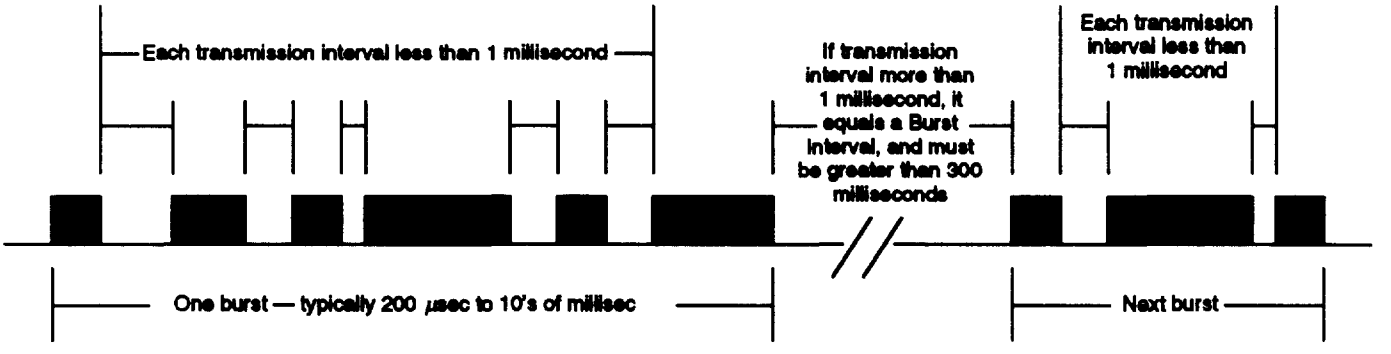

FIGURE 1: Definition and Requirement of Burst Interval (Pulse durations and intervals not to scale)

It is clear that the respective performance of each of the shared operations will critically depend on the values of the specific limits, but the examples clearly show the possibilities that exist for each of the services sharing the band.